the semantics of plural events

Semantics 3, UCLA Linguistics

Spring 2022

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1 this week's goals

- an introduction to the notion of monotonicity of measurement
- a quick review of the mereology
- a quick reminder of why we consider events to be algebraic
- (a quick background on numeral classifier systems)
- some additional data: Nakanishi (2007)

2 monotonicity and measurement

- remind us: what's monotonicity on the part-whole structure / cumulativity of reference / homogeneity / quantization?
- in what domains have we examined monotonicity?
- this week we'll start thinking about it in the context of dimensions of measurement
  - what's a dimension of measurement?
  - how do we know which one we're working with?
- a huge contribution in this area: Schwarzschild (2006)

(1) a. 2-inch cable — *attributive MP*
b. 2 inches of cable — *pseudopartitive MP*[1]

(2) a. 18-karat gold — *attributive MP*
b. *18 karats of gold — *pseudopartitive MP*

  - two empirical claims:
    1. pseudopartitives can only encode dimensions of measurement that are monotonic on the part-whole structure of the entity they're measuring
    2. attributive configurations can only encode dimensions of measurement that are non-monotonic on the part-whole structure of the entity they're measuring
  - monotonicity on the (relevant) part-whole structure, two characterizations:

(3) A dimension of measurement Dim is non-monotonic iff $\forall x, y[x \leq y \rightarrow x =_{DIM} y]$, 'All parts of y have the dimension to the same extent as x").

[1] What's a partitive? Why is this one a pseudo?

(4) a measure function μ is monotonic relative to a domain I iff:
(i) there are two individuals x, y in I such that x is a proper subpart of y, and
(ii) $\mu(x) < \mu(y)$

- pop quiz: is weight monotonic? (which one, collective or distributive?)
- what would we expect in terms of other alternations (tense/aspect/stage-level)? (where have we seen this before?!)
- a related observation: constructions with quantity words (*much, many, few, little*), too, require monotonicity

(5) Much rice was consumed that day.
a. *possible dimensions*: volume, weight
b. *prohibited dimensions*: stickiness, expense-per-unit

(6) Kendra has as much cheese as she does beer.
a. *possible dimensions*: volume, weight
b. *prohibited dimensions*: age, acidity

3 algebraic semantics and mereolgy

- review from Champollion (2017), summarizing work by Link, Bach, Krifka
- we need a notion of a partial order[2]

(7) **definition: proper part** (a proper part of a thing is a part of it that is distinct from it)
$x < y =_{def} x \leq y \wedge x \neq y$

(8) **definition: overlap** (two things overlap iff they have a part in common)
$x \circ y =_{def} \exists z[z \leq x \wedge z \leq y]$

(9) **definition: sum** (a sum of a set P is a thing that contains everything in P and whose parts each overlap with something in P)
$\textsc{sum}(x, P) =_{def} \forall y[P(y) \rightarrow y \leq x] \wedge \forall z[z \leq x \rightarrow \exists z'[P(z') \wedge z \circ z']$

- we need to be able to talk about (unique and maximal) sums

(10) **axiom of uniqueness of sums** (every nonempty set has a unique sum)
$\forall P[P \neq \emptyset \rightarrow \exists! z[\textsc{sum}(z, P)]$

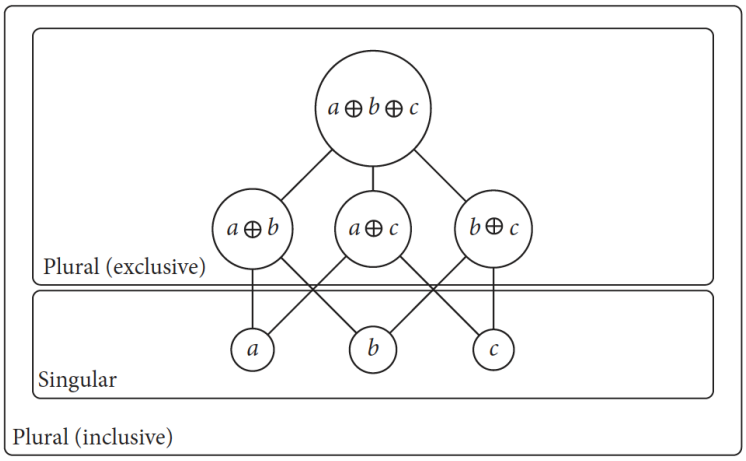
(11) **definition: binary sum** (the sum of two things is the thing which contains both of them and whose parts overlap with one of them)
$x \oplus y$ is defined as $\iota z.\textsc{sum}(z, \{x, y\})$

(12) **definition: generalized sum** (the sum of a set P is the thing which contains every element of P and whose parts each overlap with an element of P)
For any nonempty set P, its sum $\bigoplus P$ is defined as $\iota z.\textsc{sum}(z, P)$

- now we can define the mereology[3]

(13) **definition: mereology**
Let S be a set and $\leq$ be a relation from S to S. A pair $\langle S, \leq \rangle$ is called a mereology iff $\leq$ satisfies the axioms of transitivity and uniqueness.

[2] Assuming the **Axiom of reflexivity**, namely that everything is part of itself ($\forall x[x \leq x]$).
[3] Assuming the **Axiom of transitivity**, namely that any part of any part of a thing is itself part of that thing ($\forall x, y, z[x \leq y \wedge y \leq z \rightarrow x \leq z]$).



- what's the benefit (relative to set theory)?

  > "[T]he standard axioms of set theory do not permit infinitely descending chains of set membership of the kind... $e''' \in e'' \in e' \in e$. At the bottom of every set membership chain, there must be something that does not have any members itself. In mereological terms, this means that everything is ultimately composed of atoms. A restriction to atomistic mereologies causes problems for the modeling of events, mass entities, and spatiotemporal intervals, where one does not want to be forced to assume the existence of atoms. To avoid this problem, one needs to reject the relevant axioms of set theory." (Champollion, 2017, 35)

- some semantically useful definitions, then:

  (14) **definition: cumulative reference** (a predicate P is cumulative iff whenever it holds of two things, it also holds of their sum)
  $\textsc{cumul}(P) =_{def} \forall x[P(x) \rightarrow \forall y[P(y) \rightarrow P(x \oplus y)]]$

  (15) **definition: divisive reference** (a predicate P is divisive iff whenever it holds of something, it also holds of each of its proper parts)
  $\textsc{div}(P) =_{def} \forall x[P(x) \rightarrow \forall y[y < x \rightarrow P(y)]]$

  (16) **definition: quantized reference** (a predicate P is quantized iff whenever it holds of something, it does not hold of any of its proper parts)
  plural $\textsc{qua}(P) =_{def} \forall x[P(x) \rightarrow \forall y[y < x \rightarrow \neg P(y)]]$

- also relevant to us: spatial and temporal traces are homormorphisms

  (17) σ is a sum homomorphism: $\sigma(e \oplus e') = \sigma(e) \oplus \sigma(e')$
  (the location of the sum of two events is the sum of their locations)

  (18) τ is a sum homomorphism: $\tau(e \oplus e') = \tau(e) \oplus \tau(e')$
  (the runtime of the sum of two events is the sum of their runtimes)

- plural events
  - remind me: why do we want to think of events as algebraic?
  - (why/how would we characterize the relationship between individuals and events as a homomorphism?)

4 counting and measuring nouns

- if nouns are type $\langle e,t\rangle$, how do we analyze numerals in e.g. *two tables*?
- 'numeral classifier languages': those in which you cannot count without the use of a classifier

(19) a. liǎng *(zang) zhuozi
two CL table
'two tables'
b. liǎng *(píng) jiǔ
two CL.bottle wine
'two bottles of wine'

- standard theories (useful review from Bale and Coon, 2014):
  - Chierchia (1998): nonclassifier languages have a count/mass distinction; classifier languages don't

(20) a. $[\![\text{liǎng}]\!] = \lambda P : \text{atom}(P).\{x : *P(x) \wedge \mu_{\#}(x) = 2\}$
b. $[\![\text{zang}]\!] = {}^{\cup}$ (i.e., the function from kinds to sets of atoms)

(21) equivalence: $[\![\text{zang}]\!]([\![\text{zhuozi}]\!]) = \{x : \text{atom}(x) \wedge \text{table}(x)\} = [\![\text{table}]\!]$

  - Krifka (1995): nonclassifier languages incorporate measure functions into their nouns, classifier languages don't

(22) a. $[\![\text{zhuozi}]\!] = \{x : \text{atom}(x) \wedge \text{table}(x)\}$
b. $[\![\text{liǎng}]\!] = \lambda m \lambda P : \text{atom}(P).\{x : *P(x) \wedge m(x) = 2\}$

(23) equivalence: $[\![\text{liǎng}]\!]([\![\text{zang}]\!]) = \lambda P : \text{atom}(P).\{x : *P(x) \wedge \mu_{\#}(x) = 2\} = [\![\text{two}]\!]$

- split-MP constructions in Japanese

(24) a. [Gakusei-ga san-nin]-ga ie-ni kaet-ta (koto).
[student three-CL]-NOM home-to go-PAST (the fact that)
b. Gakusei-ga ie-ni san-nin kaet-ta (koto).
student-NOM home-to three-CL go-PAST
'Three students went home.'

(25) a. [Mizu san-rittoru]-ga tukue-nouede kobore-ta (koto).
[water three-liter]-NOM table-on spill-PAST
b. Mizu-ga tukue-nouede san-rittoru kobore-ta (koto).
water-NOM table-on three-liter spill-PAST
'Three liters of water spilled on the table.'

5 counting and measuring events

- Nakanishi's semantic claim:
  - non-split MP constructions measure individuals
  - split MP constructions measure events and individuals
- her corresponding syntactic claim:
  - non-split MP constructions modify (combine with) a nominal predicate
  - split MP constructions modify (combine with) a verbal predicate

- semantic evidence:
  - same monotonicity restriction in nominal domain

    (26) a. John-ga [waiyaa san-inti]-o kinoo kat-ta (koto).
    John-NOM [wire three-inch]-ACC yesterday buy-PAST
    b. John-ga waiyaa-o knoo san-inti kat-ta (koto).
    John-NOM wire-ACC yesterday three-inch buy-PAST
    'John bought three inches of water yesterday.' (*length not width*)

  - different monotonicity restrictions in the verbal domain[4]
    - a difference in compatibility with certain predicates

      (27) a. [Gakusei san-nin]-ga kinoo Peter-o {tatai-ta / korosi-ta} (koto).
      [student three-CL]-NOM yesterday Peter-ACC {hit-PAST / kill-PAST
      b. Gakusei-ga kinoo san-nin Peter-o {tatai-ta / ??korosi-ta} (koto)
      student-NOM yesterday three-CL Peter-ACC {hit-PAST / kill-PAST}
      'Three students {hit / killed} Peter yesterday.'

    - also a stage/individual-level distinction
    - also a difference in the availability of the collective reading

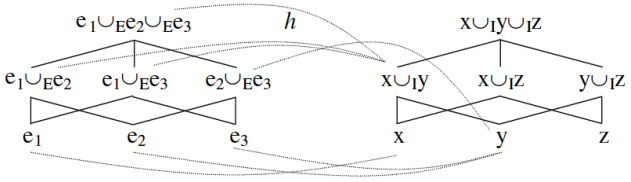
      (28) a. [Tomodati huta-ri]-ga kyonen kekkonsi-ta (koto).
      friend two-CL-NOM last-year marry-PAST
      b. Tomodati-ga kyonen huta-ri kekkonsi-ta (koto)
      friend-NOM last-year two-CL marry-PAST
      'Two friends got married last year.'

- analysis:
  - MP constructions require monotonicity on the part-whole structure
  - monotonicity in the verbal domain amounts to plural, atelic events

- formal ingredients:
  - Krifka's event-to-individual homomorphism h:

    (29) $\forall e[\mu'(e) = \mu(h(e))]$

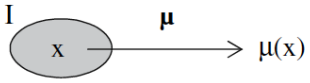
(28)



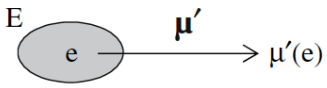
[4]Metaphysics of zombies confusion alert: "More precisely, the split MP construction is incompatible with VPs denoting an event that can occur only once such as *kill Peter*. Indeed, [the sentence] with *kill* is [only – JR] acceptable in the context where Peter is a zombie who can possibly die multiple times.

- three possible interpretations:

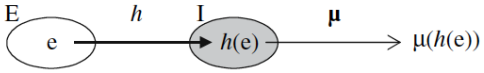
(23) A measure function associated with a non-split MP



(24) A measure function associated with a split MP

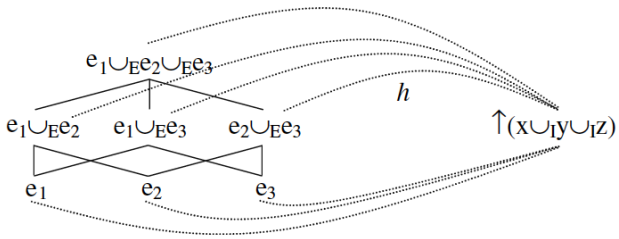


(25) A measure function associated with a split MP



- the analysis in action:
  - the collective reading is non-monotonic

(32)



  - interestingly, the collective form is available when the verb is in the progressive

(30) Otokonoko-ga kinoo san-nin isu-o tukut-tei-ta (koto).
boy-NOM yesterday three-CL chair-ACC make-PROG-PAST
'Three boys were making a chair yesterday.'

- this should all be reminiscent of other floating quantifiers, cf. *Combien as-tu lu t_i de livres?*, Doetjes (1997).

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